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**Key indicators**

Single-crystal X-ray study  
 T = 203 K  
 Mean  $\sigma(\text{C}-\text{C}) = 0.003 \text{ \AA}$   
 R factor = 0.026  
 wR factor = 0.072  
 Data-to-parameter ratio = 15.5

For details of how these key indicators were  
 automatically derived from the article, see  
<http://journals.iucr.org/e>.

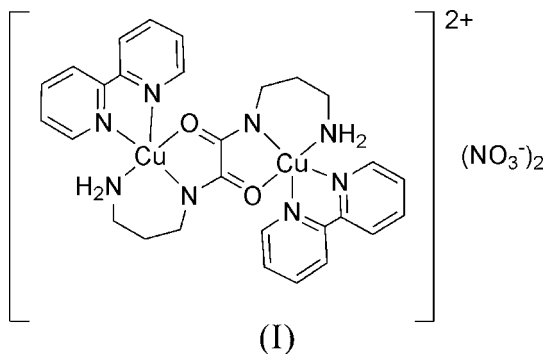
**$[\mu\text{-}N,N'\text{-Bis(3-aminopropyl)oxamidato(2-)}]\text{-bis[(2,2'\text{-bipyridine) copper(II)}] \text{ dinitrate}$**

The title compound,  $[\text{Cu}_2(\text{C}_8\text{H}_{16}\text{N}_4\text{O}_2)(\text{C}_{10}\text{H}_8\text{N}_2)_2](\text{NO}_3)_2$ , contains a centrosymmetric binuclear copper(II) complex bridged by a deprotonated oxamide ligand. The Cu atoms have a distorted square-pyramidal coordination geometry, with one of the 2,2'-bipyridine N atoms at the apex. The copper complex cations assemble in chains along the *c* axis via  $\pi\text{-}\pi$  overlaps of bipyridine ligands of neighbouring complexes. These chains are connected in the crystal structure via  $\text{N}-\text{H}\cdots\text{O}$  and  $\text{C}-\text{H}\cdots\text{O}$  hydrogen bonds with the nitrate ions.

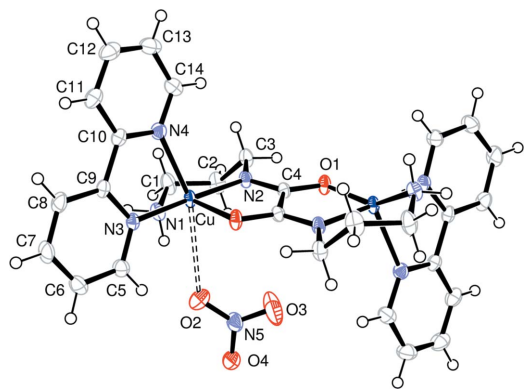
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**Comment**

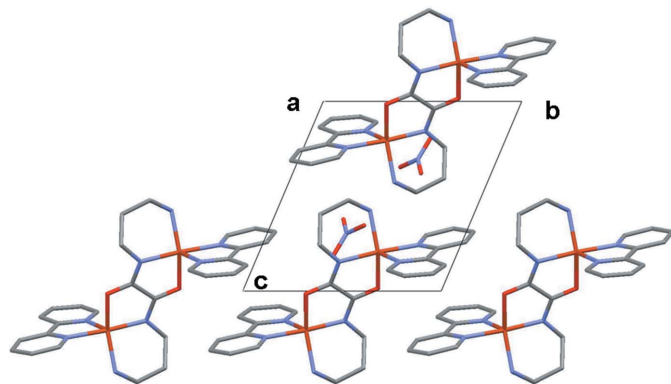
The oxamidate dianion is a versatile bridging ligand used in the design and synthesis of polymetallic complexes (Ojima & Nonoyama, 1988; Ruiz *et al.*, 1999). A large variety of homo- and heterobinuclear complexes of multidentate ligands based on functionalized oxamides have been reported. The title complex, (I), was prepared by Ojima & Nonoyama (1972) from a reaction of *N,N'*-bis(3-aminopropyl)oxamidato-copper(II), Cu(apoxd), with mono(2,2'-bipyridine)copper(II) nitrate,  $[\text{Cu}(\text{bipy})](\text{NO}_3)_2$ , in alkaline solution, and was characterized by magnetic and spectroscopic measurements.



The molecular structure of (I),  $[\text{Cu}_2(\text{apoxd})(\text{bipy})_2](\text{NO}_3)_2$ , is shown in Fig. 1. The complex cation,  $[\text{Cu}_2(\text{apoxd})(\text{bipy})_2]^{2+}$ , is a centrosymmetric dimer. Two five-coordinate  $\text{Cu}^{\text{II}}$  ions are bridged by the deprotonated oxamide group of the *N,N'*-bis(3-aminopropyl)oxamide ligand in a *trans* conformation, with  $\text{Cu}\cdots\text{Cu} = 5.2504(4) \text{ \AA}$ . Each five-coordinate  $\text{Cu}^{\text{II}}$  ion has a near square-pyramidal geometry, with a longer contact to atom O2 [3.115(3)  $\text{ \AA}$ ] of the nitrate anion from beneath the basal plane of the coordination pyramid (Table 1). Atoms N2 and O1 of the bridging oxamidate anion occupy adjacent positions on the base of the pyramid along with atoms N1 and N3. Atom N4 of the 2,2'-bipyridine ligand is at the apex of the pyramid, with the  $\text{Cu}-\text{N4}$  distance significantly longer than the basal  $\text{Cu}-\text{N3}$  distance, indicative



**Figure 1**  
The molecular structure of (I), showing the atom-numbering scheme, with 50% probability displacement ellipsoids. H atoms are shown as arbitrary spheres. The dashed line indicates a hydrogen bond. (Symmetry code for unlabelled atoms:  $-x, 1 - y, -z$ .)



**Figure 2**  
The packing arrangement of complex (I), viewed along the  $a$  axis, showing the  $\pi$ - $\pi$  stacking between complex cations. H atoms have been omitted.

of a Jahn–Teller distorted geometry. The 12-atom plane of the 2,2'-bipyridine ligand (C5–C14/N3/N4, r.m.s. deviation 0.05 Å) makes an angle of 88.10 (4)° to the Cu/O1/N1/N2/N3 basal plane (r.m.s. deviation 0.252 Å). The overall molecular geometry of the  $[\text{Cu}_2(\text{apoxd})(\text{bipy})_2]^{2+}$  cation is very similar to an analogous  $[\text{Cu}_2(\text{apoxd})(\text{pyrimidine})_2]^{2+}$  complex cation (Dominguez-Vera *et al.*, 1998) and a related  $[\text{Cu}_2(\text{aeoxd})(\text{diazfluorenone})_2]^{2+}$  complex (Li *et al.*, 2005).

The ions of (I) assemble in the crystal structure as shown in Fig. 2. The dimeric units form chains along the  $c$  axis via  $\pi$ - $\pi$  stacking of the 2,2'-bipyridine ligands with those of adjacent complexes (interplanar distance 3.459 Å). The O atoms of the nitrate ion form hydrogen bonds to H atoms on the primary amine atom N1, the methylene C atoms C1 and C3, and bipyridine C atoms C7 and C8 (Table 2). These connect each of the  $[\text{Cu}_2(\text{apoxd})(\text{bipy})_2]^{2+}$  cation chains within the crystal structure.

## Experimental

Complex (I) was prepared and crystallized as described by Ojima & Nonoyama (1972).

## Crystal data

$[\text{Cu}_2(\text{C}_8\text{H}_{16}\text{N}_4\text{O}_2)(\text{C}_{10}\text{H}_8\text{N}_2)_2](\text{NO}_3)_2$   
 $M_r = 763.72$   
 Triclinic,  $P\bar{1}$   
 $a = 8.9069$  (3) Å  
 $b = 10.3003$  (4) Å  
 $c = 10.3457$  (4) Å  
 $\alpha = 103.290$  (1)°  
 $\beta = 107.605$  (1)°

$\gamma = 112.436$  (1)°  
 $V = 769.31$  (5) Å<sup>3</sup>  
 $Z = 1$   
 $D_x = 1.648$  Mg m<sup>-3</sup>  
 Mo  $K\alpha$  radiation  
 $\mu = 1.45$  mm<sup>-1</sup>  
 $T = 203$  (2) K  
 Prism, green  
 $0.20 \times 0.18 \times 0.15$  mm

## Data collection

Siemens SMART CCD area-detector diffractometer  
 $\omega$  scans  
 Absorption correction: multi-scan (SADABS; Sheldrick, 1996)  
 $T_{\min} = 0.760$ ,  $T_{\max} = 0.812$

7305 measured reflections  
 3353 independent reflections  
 3123 reflections with  $I > 2\sigma(I)$   
 $R_{\text{int}} = 0.015$   
 $\theta_{\text{max}} = 27.5^\circ$

## Refinement

Refinement on  $F^2$   
 $R[F^2 > 2\sigma(F^2)] = 0.026$   
 $wR(F^2) = 0.072$   
 $S = 1.06$   
 3353 reflections  
 217 parameters  
 H-atom parameters constrained

$w = 1/[\sigma^2(F_o^2) + (0.0412P)^2 + 0.358P]$   
 where  $P = (F_o^2 + 2F_c^2)/3$   
 $(\Delta/\sigma)_{\text{max}} < 0.001$   
 $\Delta\rho_{\text{max}} = 0.62$  e Å<sup>-3</sup>  
 $\Delta\rho_{\text{min}} = -0.50$  e Å<sup>-3</sup>

**Table 1**

Selected geometric parameters (Å, °).

Cu–N2	1.9468 (13)	Cu–N3	2.0173 (14)
Cu–O1 <sup>i</sup>	2.0126 (12)	Cu–N4	2.2276 (15)
Cu–N1	2.0166 (14)		
N2–Cu–O1 <sup>i</sup>	83.86 (5)	N1–Cu–N3	91.03 (6)
N2–Cu–N1	92.71 (6)	O1 <sup>i</sup> –Cu–N4	104.96 (5)
O1 <sup>i</sup> –Cu–N1	149.59 (6)	N1–Cu–N4	105.21 (6)
N2–Cu–N3	175.79 (5)	N3–Cu–N4	77.33 (6)
O1 <sup>i</sup> –Cu–N3	91.94 (5)		

Symmetry code: (i)  $-x, -y + 1, -z$ .

**Table 2**

Hydrogen-bond geometry (Å, °).

$D-H\cdots A$	$D-H$	$H\cdots A$	$D\cdots A$	$D-H\cdots A$
N1–H1A $\cdots$ O2	0.91	2.21	2.928 (2)	135
N1–H1A $\cdots$ O2 <sup>ii</sup>	0.91	2.63	3.080 (2)	111
N1–H1D $\cdots$ O4 <sup>ii</sup>	0.91	2.16	3.032 (2)	161
C1–H1B $\cdots$ O4 <sup>iii</sup>	0.98	2.53	3.413 (3)	150
C3–H3B $\cdots$ O4 <sup>iii</sup>	0.98	2.68	3.528 (2)	145
C7–H7A $\cdots$ O4 <sup>iv</sup>	0.94	2.45	3.348 (2)	160
C8–H8A $\cdots$ O3 <sup>iv</sup>	0.94	2.65	3.253 (3)	122

Symmetry codes: (ii)  $-x, -y + 1, -z + 1$ ; (iii)  $x + 1, y, z$ ; (iv)  $x, y - 1, z$ .

H atoms were placed in calculated positions and refined using a riding model, with C–H = 0.93–0.98 Å and N–H = 0.91 Å, and with  $U_{\text{iso}}(\text{H}) = 1.2U_{\text{eq}}(\text{C}, \text{N})$  for methylene and amine H atoms, or  $1.5U_{\text{eq}}(\text{C})$  for aromatic C atoms in the bipyridine group.

Data collection: SMART (Siemens, 1995); cell refinement: SAINT (Siemens, 1995); data reduction: SAINT; program(s) used to solve structure: SHELXS97 (Sheldrick, 1997); program(s) used to refine structure: SHELXL97 (Sheldrick, 1997); molecular graphics: ORTEP-3 for Windows (Farrugia, 1997) and MERCURY (Macrae *et al.*

*al.*, 2006); software used to prepare material for publication: *WinGX* (Farrugia, 1999).

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